Michael:

I attaching a couple of revised items. The main changes have to do with probe location (stack diameters). The numbers I received from Tim in the CiSCO QA questionnaire were different from the numbers you have. In addition, I believe the sites preference is to create separate documents for the the CERMS and the FGAS units. I have attached the CiSCO overview documents that we would include with the RAta protocol for review. If anyone has questions please contact me.

Reggie

From: mjpierce27@aol.com [mailto:mjpierce27@aol.com]
Sent: Monday, March 13, 2006 3:09 PM
To: Reginald Williams; dolly.potter@solvay.com; tim.brown@solvay.com
Subject: Evergreen's RATA Protocol

Hey Everyone,

The protocol is enclosed for review. Please let me know any comments/changes you have.

Thank you,

Michael Pierce
303-679-6440

Sample Calculations

Volume of Water Vapor Collected (wscf)

$$V_{wstd} = 0.04707 \, x V_{wc} + 0.04715 \, x W_{sg}$$

   Where:

V_{wstd}	volume of water vapor collected at standard conditions (scf)
V_{wc}	volume of liquid collected in the impingers (ml)
W_{sg}	weight of liquid collected in silica gel (g)
0.04715	conversion factor (ft^3/g)
0.04707	conversion factor (ft^3/ml)

Volume of Gas Sample, Corrected to Standard Conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_b + \dfrac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

   Where:

V_{mstd}	volume of gas sample, corrected to standard conditions (scf)
V_m	volume of gas sample at meter conditions (ft^3)
P_b	barometric pressure (in. Hg)
ΔH	average pressure drop across meter orifice (in. H_2O)
Y_d	gas meter correction factor (dimensionless)
T_m	average dry gas meter temperature (^{o}F)
13.6	conversion factor (in. H_2O/in. Hg)
17.64	ratio of standard temperature over standard pressure (^{o}R/in. Hg)
460	conversion factor (^{o}F to ^{o}R)

Stack Gas Pressure (in. Hg)

$$P_a = P_b + \left(\frac{P_s}{13.6}\right)$$

   Where:

P_a	absolute sample gas pressure (in. Hg)
P_b	barometric pressure (in. Hg)
P_s	static pressure (in. H_2O)
13.6	conversion factor (in. H_2O/in. Hg)

Moisture Content (%)

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$

Where:

B_{wo}	water vapor of the gas stream (%)
V_{mstd}	volume of gas sample, corrected to standard conditions (scf)
V_{wstd}	volume of water vapor collected at standard conditions (scf)
100	conversion factor

Molecular Weight of Dry Gas Stream (lb/lb-mole)

$$M_d = MW_{CO_2} \frac{(\%CO_2)}{(100)} + MW_{O_2} \frac{(\%O_2)}{(100)} + MW_{CO+N_2} \frac{(\%CO + \%N_2)}{(100)}$$

Where:

M_d	molecular weight of the dry gas stream (lb/lb-mole)
MW_{CO2}	molecular weight of carbon dioxide (lb/lb-mole)
MW_{O2}	molecular weight of oxygen (lb/lb-mole)
MW_{CO+N2}	molecular weight of carbon monoxide and nitrogen (lb/lb-mole)
$\%CO_2$	carbon dioxide concentration in the dry gas stream (%)
$\%O_2$	oxygen concentration in the dry gas stream (%)
$\%CO + \%N_2$	carbon monoxide and nitrogen in the dry gas stream (%)
100	conversion factor

Molecular Weight of Wet Gas Stream (lb/lb-mole)

$$M_s = (M_d)(1 - B_{wo}) + (MW\,H_2O)(B_{wo})$$

Where:

M_s	molecular weight of the wet gas stream (lb/lb-mole)
M_d	molecular weight of the dry gas stream (lb/lb-mole)
MW_{H2O}	molecular weight of water (lb/lb-mole)
B_{wo}	water vapor of the gas stream (%)

Velocity of Gas Stream (ft/sec)

$$V_s = (85.49)(C_p)\left(\overline{\sqrt{\Delta P}}\right)\left(\sqrt{\frac{\overline{(T_s + 460)}}{(M_s)(P_a)}}\right)$$

Where:

V_s	gas stream velocity (ft/sec)
85.49	pitot tube constant (ft/sec)([lb/lb-mole)(in. Hg)]/[(^{o}R)(in. H_2O)])$^{1/2}$
C_p	pitot tube coefficient (dimensionless)
$\sqrt{\Delta P}$	average square roots of velocity pressures (in. H_2O)$^{1/2}$
T_s	average gas stream temperature (^{o}F)
M_s	molecular weight of the wet gas stream (lb/lb-mole)
P_a	absolute sample gas pressure (in. Hg)
460	conversion (^{o}F to ^{o}R)

Volumetric Flow Rate of Gas Stream (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

Q_a	volumetric flow rate of gas stream at actual conditions (acfm)
V_s	gas stream velocity (ft/sec)
A_s	cross sectional area of sample location (ft^2)
60	conversion factor (sec/min)

Volumetric Flow Rate of Gas Stream (scfm)

$$Q_{std} = \frac{17.64(Q_a)(P_a)}{(T_s + 460)}$$

Where:

Q_{std}	volumetric flow rate of gas stream at standard conditions (scfm)
Q_a	volumetric flow rate of gas stream at actual conditions (acfm)
P_a	absolute sample gas pressure (in. Hg)
T_s	average gas stream temperature (^{o}F)
460	conversion (^{o}F to ^{o}R)
17.64	ratio of standard temperature over standard pressure (^{o}R/in. Hg)

Volumetric Flow Rate of Gas Stream (dscfm)

$$Q_{dstd} = (Q_{std})(1 - B_{wo})$$

Where:

Q_{dstd}	volumetric flow rate of gas stream at standard conditions, dry basis (dscfm)
Q_{std}	volumetric flow rate of gas stream at standard conditions (scfm)
B_{wo}	water vapor of the gas stream (%)

Nitrogen Oxides Concentration (drift corrected, ppmdv)[1]

$$C_{corr} = \left(C - \left(\frac{C_{oi} + C_{of}}{2} \right) \right) \left(\frac{C_{ma}}{\left(\frac{C_{mi} + C_{mf}}{2} \right) - \left(\frac{C_{oi} + C_{of}}{2} \right)} \right)$$

Where:

C_{corr}	nitrogen oxides concentration, corrected for analyzer drift (ppmdv)
C	nitrogen oxides concentration (ppmdv)
C_{oi}	initial system calibration bias check response for the zero gas (ppm)
C_{of}	final system calibration bias check response for the zero gas (ppm)
C_{mi}	initial system calibration bias check response for the upscale gas (ppm)
C_{mf}	final system calibration bias check response for the upscale gas (ppm)
C_{ma}	actual concentration of the upscale calibration gas (ppm)

Nitrogen Oxides Emission Rate (lb/hr)

$$E_{lb/hr} = \frac{(C_{corr})(MW_{NOx})(Q_{dstd})(60)}{(385.3)(10^6)}$$

Where:

$E_{lb/hr}$	nitrogen oxides emission rate (lb/hr)
C_{corr}	nitrogen oxides concentration, corrected for analyzer drift (ppmdv)
MW_{NOx}	molecular weight of nitrogen oxides (lb/lb-mole)
Q_{dstd}	volumetric flow rate of gas stream at standard conditions, dry basis (dscfm)
60	conversion factor (min/hr)
385.3	volume occupied by one pound of gas at standard conditions (dscf/lb-mole)
10^6	conversion factor (fraction to ppm)

---

[1] Calculations for oxygen and carbon dioxide are performed in the same manner.

Nitrogen Oxides Emission Rate (lb/10^{6}Btu, Heat Input)

$$E_{lb/10^6 Btu} = \frac{\left(E_{NOx\,lb/hr}\right)}{\left(E_{10^6\,Btufired/hr}\right)}$$

Where:

$E_{lb/10^6Btu}$	nitrogen oxides emission rate (lb/10^{6}Btu, Heat Input)
$E_{NOx\,lb/hr}$	nitrogen oxides emission rate (lb/hr)
$E_{10^6\,Btu/hr}$	emission rate (10^{6}Btu fired/hr)

RATA Calculations

Standard Deviation

$$S_{dev} = \sqrt{\frac{\sum_{i=1}^{n} d_i^2 - \frac{\left(\sum_{i=1}^{n} d_i\right)^2}{n}}{(n-1)}}$$

Where:

S_{dev}	standard deviation
Σ	summation
n	number of data sets used for calculations
d_i	difference between the reference method result and the CEM value for a given run
i	run number

Confidence Coefficient

$$CC = (t_{0.975})\frac{\left(S_{dev}\right)}{\left(\sqrt{n}\right)}$$

Where:

CC	confidence coefficient
S_{dev}	standard deviation
n	number of data sets used for calculations
$t_{0.975}$	the inverse of the Student's t-distribution for the specified degrees of freedom

Relative Accuracy

$$RA = \left(\frac{\left| \overline{d}_{avg} \right| + \left| CC \right|}{RM_{avg} \ or \ E_{s \tan dard}} \right) x100$$

Where:

RA	relative accuracy
CC	confidence coefficient
d_{avg}	mean of the differences
RM_{avg}	reference method average
$E_{standard}$	applicable emission standard
100	conversion factor (%)

**SOLVAY SODA ASH JOINT VENTURE
GREEN RIVER, WYOMING**

**CONTINUOUS EMISSIONS MONITORING SYSTEM
CERTIFICATION TEST PROTOCOL**

PREPARED FOR: SOLVAY CHEMICALS, INC.

PREPARED BY: CUSTOM INSTRUMENTATION SERVICES, CORP.

3/21/16

CERTIFICATION TEST PROTOCOL

1.0   OVERVIEW

Solvay Chemicals, Inc. owns and operates Solvay Soda Ash Joint Venture Plant, a sodium carbonate manufacturing facility located in Green River, Wyoming. The facility consists of two stoker coal fired (originally a gas fired site) Calciners with one shared common stack. The Calciners will use Selective Non-Catalytic Reduction (SNCR), Flue Gas Recirculation (FGR) and water injection to control NO_x formation. Emissions from the stack will be monitored by a dedicated continuous emissions monitoring system (CEMS). The CEMS for purpose of this protocol includes both the continuous emissions rate monitoring system (CERMS) and the continuous opacity monitoring system (COMS) is located at the base of the stack. Exhaust gases from the units are discharged into the atmosphere through a common stack approximately 110 feet above grade.

The Air Permit issued by the Wyoming Department of Environmental Quality (WDEQ) requires Continuous Emission Monitoring Systems (CEMS) for oxides of nitrogen (NO_x), oxygen (O_2), stack flow and opacity be installed on the exhaust stack of the Calciners.   The CEMS instrumentation will be used to demonstrate continuous compliance with the allowable emission limitation set forth in the permit. The CEMS will meet the monitoring and reporting requirements of the following:

Title 40 CFR, Part 60, Appendix B

> Performance Specification (PS) 1 - *Specifications and Test Procedures for Continuous Opacity Monitoring Systems in Stationary Sources*
> Performance Specification (PS) 2 - *Specifications and Test Procedures for SO_2 and NO_x Continuous Emission Monitoring Systems in Stationary Sources*
> Performance Specification (PS) 3 - *Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems in Stationary Sources*
> Performance Specification (PS) 6 - *Specifications and Test Procedures for Continuous Emission Rate Monitoring Systems in Stationary Sources*

WDEQ Permit Number: MID-995

> Condition 17.B – *Requirements of Wyoming Air Quality Standards and Regulation (WAQSR), Chapter 5, section 2(j).*

2.   CERTIFICATION STRATEGY

The certification testing includes procedures to satisfy both WDEQ and 40 CFR 60 regulations. To verify the accuracy of the analyzers and the sample locations, field-testing will be conducted on the CEMS (CERMS and COMS). The 40 CFR 60 testing on all analyzers consists of a Relative Accuracy Test Audit (RATA), and calibration drift test. Additionally, WDEQ certification requirements for the NO_x and O_2 analyzers for the Calciners also include a linearity check. All testing will be performed while the plant is operating at normal load. In addition, testing will be performed on the DAHS to verify formulas and missing data routines. All tests will be performed according to the prescribed methodologies described in 40 CFR Part 60 Appendix B. The WDEQ

linearity requirement will follow the procedures provided in 40 CFR Part 75 Appendix A. The pass/fail criteria for each test are listed in Table 1.

2.1   Relative Accuracy Test Audit

Evergreen Air Services of Evergreen, Colorado was contracted by Custom Instrumentation Services, Corp. (CiSCO), the FGAS contractor, to provide testing to support the 40 CFR 60 Relative Accuracy Test Audits (RATA) at the Solvay Soda Ash Joint Venture Plant. The RATA procedures are outlined in the Evergreen Air Services test protocol (attached). During the test, the DAHS will record values every minute and then averaged for the duration of the test period. These values are compared to the test teams values for the same test period.

When the testing is completed, the data is used to calculate relative accuracy using the formulas in 40CFR60, Appendix B, PS2, Section 12.0. Relative accuracy is reported as an error and is the sum of the absolute mean value of the differences between the reference method tests and the instrument readings, plus the 95 percent confidence interval of the differences, expressed as a percentage of the mean reference method value. The NO_x, O_2, and flow analyzers must pass the relative accuracy requirements of 40 CFR 60.

2.2   Linearity Check

CiSCO will perform the linearity test required by WDEQ according to the 40CFR75, Appendix A Section 6.2 requirements. The NO_x analyzers and O_2 analyzers will be challenged three times with each of three levels of calibration gas (low, mid and high). The mean difference between the analyzer response and the calibration gas value, as a percentage of the calibration gas value, must be within 5%. Results are also acceptable if the difference between the mean response and the calibration gas is within 5 ppm NO_x and 0.5% O_2. The results for the three runs will be included in the final report. The gases to be used are listed in Table 2.

2.3   CEMS Calibration Drift Tests

In accordance with 40 CFR 60, Appendix B, Performance Specification (PS) 2, 3 and 6, calibration drift tests shall be performed once a day for seven consecutive days or on the stack analyzers for the Calciners. Performance Specification 2, 3 and 6 require the NO_x, O_2 and flow analyzers meet a limit of 2.5, 0.5 and 3.0 percent drift, respectively. These limits can be found in Section 13.1 of PS2, 3 and 6.

2.4   COMS Certification Tests

In accordance with 40 CFR 60, Appendix B, Performance Specification (PS) 1 requires Field Audit Performance Tests, Operational Tests, and Opacity Monitor Manufacturer requirements to be met for the certification of the opacity monitor. Performance Specification 1 limits for the opacity monitor are provided below in Tables 3 and 4 as well as in Section 13.0 in PS1.

2.5   DAHS TESTING

Formula verification will be performed by printing out individual record types, showing all the values that are used in calculations (lb/mmBtu, heat input, etc.) and comparing the values to ones calculated using a calculator.

TABLE 1.
CEMS CERTIFICATION PERFORMANCE SPECIFICATIONS

REQUIRED TEST	PERFORMED BY:	PASS/FAIL CRITERIA	CITATION
RATA NO_x ppm @ 15% O_2, lb/mmBtu	Evergreen Air Services	20% RA or 10% of standard	40CFR60 PS2

LINEARITY
   NO_x
   O_2
	CiSCO	5% of gas value or 5 ppm
		5% of gas value or 0.5% O_2
			40CFR75 Appendix A, Section 6.2

CALIBRATION ERROR
   NO_x
   O_2
	CiSCO/Solvay	2.5% of span or 5 ppm
		0.5% O_2
			40CFR75 Appendix A, Section 6.3

CALIBRATION DRIFT TEST
   NO_x
   O_2
   Flow
	CiSCO/Solvay	2.5% of zero or span
		0.5% O_2
		3.0% of zero or span
			40CFR60 PS2
			40CFR60 PS3
			40CFR60 PS6

CYCLE TIME TEST	CiSCO	<15 minutes	40CFR75 Appendix A, Section 6.4
DAHS ACCURACY	CiSCO	Verify formulas and missing data routines	40CFR75
COMS MANUFACTURER CERTIFICATION TESTS	Opacity Manufacturer	Verification of Design and Performance Specifications	40 CFR 60, App. B, PS 1, Sect. 8.2
COMS FIELD AUDIT PERFORMANCE TESTS	CiSCO	Optical Alignment, Calibration Error, System Response Time, Averaging Period	40 CFR 60, App. B, PS 1, Sect. 8.1(3)
COMS OPERATIONAL TESTING	CiSCO	Zero Calibration Drift, Upscale Calibration Drift	40 CFR 60, App. B, PS 1, Sect. 8.1(4)

TABLE 2.
GAS REQUIREMENTS FOR CERTIFICATION

	GAS TYPE	CONCENTRATION	INJECTION POINT

LINEARITY CHECK - Stack	EPA Protocol 1	O_2 - low = 4.2 - 6.0%
		        - mid = 10.5 - 12.0%
		        - high = 21% air
		NO_x high - low = 80 - 120 ppm
		        - mid = 200 - 240 ppm
		        - high = 320 - 400 ppm
			probe

CALIBRATION ERROR - Stack	Certified Master	NO_x high - zero, 320 - 400 ppm O_2 - zero, 21% air	probe

TABLE 3
SUMMARY OF MANUFACTURER'S SPECIFICATIONS AND REQUIREMENTS

Specification	Requirement
Spectral Response	Peak and mean spectral response between 500 and 600 nanometers (nm): less than 10% of peak response below 400 nm and above 700 nm
Angle of View, Angle of Protection	$< 4^o$ for all radiation above 2.5% of peak
Insensitivity to Supply Voltage Variations	<1.0% opacity max. change over specified range of supply voltage variation, or <10% variation from the nominal supply voltage
Thermal Stability	<2.0% opacity change per 40^oF change over specified operational range
Insensitivity to Ambient Light	<2.0% opacity max. change from sunrise to sunset with at least one 1-hr average solar radiation level of < 900 Watts per meter squared (W/m^2)
External Audit Filter Access	Required
External Zero Device Repeatability - Optional	<1.0% opacity
Automated Calibration Checks	Check of all active analyzer internal optics with power or curvature, all active electronic circuitry including the light source and photodetector assembly, and electric or electro-mechanical systems used during normal measurement operation
Simulated Zero Check Device	Simulated condition during which the energy reaching the detector is between 90 and 190% of the energy reaching the detector under actual clear path conditions
Upscale Calibration Check Device	Check of the measurement system where the energy level reaching the detector is between the energy levels corresponding to 10% opacity and the highest level filter used to determine calibration error
Status Indicators	Manufacturer to identify and specify
Pathlength Correction Factor Security	Manufacturer to specify one of three options
Measurement Output Resolution	0.5% opacity over measurement range from –5% to 50% opacity, or higher value
Measurement and Recording Frequency	Sampling and analyzing at least every 10 sec: calculate averages from at least 6 measurements per minute
Instrument Response Time	< 10 sec to 95% of final value
Calibration Error	< 3% opacity for the sum of the absolute value of mean difference and 95% confidence coefficient for each of three test filters
Optical Alignment Indicator – (Uniformity of Light Beam and Detector)	Clear indication of misalignment at or before the point where opacity changes <2% due to misalignment as system is misaligned both linearly and rotationally in horizontal and vertical planes
Calibration Device Repeatability	< 1.5% opacity

TABLE 4
FIELD AUDIT AND OPERATIONAL TESTING PERFORMANCE SPECIFICATIONS

Optical Alignment	Misalignment error <2 percent opacity
Calibration Error	<2 percent opacity for each of the three calibration attenuators
System Response Time	Upscale and downscale response times <10 seconds
Averaging Period Calculation and Recording	Average and record each calibration attenuator value to within 2% opacity of the certified value
Zero and Upscale Responses	<2 percent opacity over a 24 hour period
Stack Exit Correlation Error	<2 percent
Fault Indicators	Inactive – no error messages
Zero Compensation	<4 percent opacity
Optical Surface Dust Accumulation	<4 percent opacity
Zero Alignment	<5 percent opacity for one check, <2 percent opacity for three consecutive checks
Valid Data Average Capture	<95 percent of source operating time
Operational Test Period	Able to measure and record opacity and perform daily calibration drift assessments for 168 hours without unscheduled maintenance, repair or adjustment

ATTACHMENT

EVERGREEN AIR SERVICES TEST PROTOCOL

TEST PROTOCOL
RELATIVE ACCURACY TEST AUDITS

"A" CALCINER (CA-A, AQD NO. 17)
AND
"B" CALCINER (CA-B, AQD NO. 17)

CONTINUOUS EMISSION RATE MONITORING SYSTEMS

CUSTOM INSTRUMENTATION SERVICES, CORP.

March 13, 2006

EVERGREEN PROJECT NO.: M06-035

TEST PROTOCOL
RELATIVE ACCURACY TEST AUDITS

"A" CALCINER (CA-A, AQD NO. 17)
AND
"B" CALCINER (CA-B, AQD NO. 17)

CONTINUOUS EMISSION RATE MONITORING
SYSTEMS

CUSTOM INSTRUMENTATION SERVICES, CORP.
CENTENNIAL, COLORADO

EVERGREEN PROJECT NO.: M06-035

March 13, 2006

Prepared for:

Mr. Reginald Williams
Custom Instrumentation Services, Corp.
7325 S. Revere Parkway
Centennial, Colorado 80112

Prepared by:

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P.O. Box 153
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(303) 679-6440

Table of Contents

Appendices

1.0 Objective

Custom Instrumentation Services, Corp (CiSCO) has contracted Evergreen Air Services, Inc. (Evergreen) to perform relative accuracy test audits (RATAs) at the Solvay Chemicals, Inc. facility located near Green River, Wyoming. The objective of the test program is to demonstrate the relative accuracy (RA) of the continuous emission rate monitor systems (CERMS) on the "A" and "B" Calciners (AQD No. 17). All testing will meet the requirements of CiSCO, Solvay Chemicals, Inc. and the Wyoming Department of Environmental Quality (WDEQ).

1.1 RATA Methodology

Three RATAs will be conducted. The first two will be conducted at the "A" and "B" Calciner Ducts. The RA of the CERMS will be determined by comparing the results of reference method tests to the results of the installed CERMS. The RA of the NOx CERMs must be no greater than 20 percent of the mean value of the reference method's test data in terms of the emission standard or 10 percent of the applicable standard, whichever is greater. RATA results will be expressed in terms of NOx parts per million, dry volume (ppmdv), NOx pound per million Btu, heat input ($lb/10^6$ Btu), and percent O_2, dry volume (%O_2, dv). Additionally, the volumetric flow rate will be measured at each test location for the purposes of calculating NOx $lb/10^6$Btu.

The third RATA will be conducted at "A" and "B" Calciners Common Stack. The RA of the CERMS will be determined by comparing the results of reference method tests to the results of the installed CERMS. The RA of the NOx CERMs must be no greater than 20 percent of the mean value of the reference method's test data in terms of the emission standard or 10 percent of the applicable standard, whichever is greater. RATA results will be expressed in terms of NOx ppmdv, NOx pound per hour (lb/hr), NOx $lb/10^6$ Btu, heat input, percent O_2, wet volume (%O_2, wv), % O_2, dv, and volumetric flow rate expressed in terms of dry standard cubic feet per minute (dscfm).

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Specified testing will include the determination of the following:

Gas Parameters	Molecular Weight	CAS Number
• gas velocity		
• gas temperature		
• gas molecular weight		
• gas moisture content		
• volumetric flow rate		
• oxygen (O_2)	32.00	7782-44-7
• carbon dioxide (CO_2)	44.01	124-38-9
• nitrogen oxides (NOx)	46.01	10102-44-0

The test program is tentatively scheduled for mid May, 2006. Coordinating the field portion of the test program will be:

Tim Brown	Michael Pierce
Solvay Minerals, Inc	Evergreen Air Services, Inc.
20 miles west of Green River	P.O. Box 153
Green River, WY 82935	Evergreen, CO 80437
Ph: (307) 872-6570	Ph: (303) 679-6440
Fax: (307) 872-6510	Fax: (303) 670-2722
E-mail: tim.brown@solvay.com	E-mail: Mjperce27@aol.com

SOLVAY2016_1.3_000824

2.0 Introduction

2.1 Description of Installation

Solvay Chemicals, Inc., located near Green River, Wyoming, is a mine and refinery with corporate offices in Houston, Texas.

The primary raw material for the Green River facility is sodium sesquicarbonate, commonly referred to as trona. The trona is mined at the plant site from an ore bed located 1,500 feet below the surface. The trona is hoisted to the surface before refining into soda ash and other sodium-based products.

The trona that is fed to the soda ash calciners is heated, resulting in thermal calcination of the sodium sesquicarbonate forming a crude soda ash. The crude soda ash is dissolved in water and the insolubles are separated from the solution by settling and filtration. The insolubles are disposed of in the mine void. The high-purity saturated solution of sodium carbonate is then fed to crystallizers where a large amount of water is removed and a slurry of sodium carbonate monohydrate crystals is formed. This slurry is then further dewatered and washed by a series of cyclones and centrifuges. The resulting monohydrate crystals are fed through dryers forming a high quality soda ash, which then is ready for storage and shipment.

The instruments to be certified are:

- NOx/O_2 analyzers manufactured by California Analytical Inc., Model 650
- Flow monitors manufactured by Optical Scientific Inc., Model OFS 2000
- O_2 wet monitor manufactured by Ametek, Series 2000

2.2 Sampling Locations

The "A" and "B" Calciner Ducts are square ten foot ducts with horizontal probe entry. EPA Method one will be used to determine the number and location of volumetric air flow measurement points. Measurement points will be determined on-site, after the distance to the nearest up and down stream disturbances are measured. EPA Performance Specification 2 will be used to determine the reference method sample points for gas concentration measurements.

The "A" and "B" Calciners Stack is a round vertical stack with a diameter of 144.0 inches. The test ports are located approximately 3.65.08 diameters downstream and approximately 4.47.08 diameters upstream from the nearest flow disturbances. EPA Method 1 will be used to determine the traverse points that will be used for gas velocity measurements. Four points in each of the four test ports will be traversed for volumetric flow determination. EPA Performance Specification 2 will be used to determine the reference method sample points for gas concentration measurements. Source identification is shown in the table below.

Unit Identification Number	AQD No. 17, CA A & B Stack
Process	Calciner
Fuel	Natural Gas and Trona Ore Coal
Heat Content	1,020 to 1,060 Btu/ft^3
Stack Height	180.5 180.0 feet
Stack Diameter	144.0 inches
Test Port- Diameters to Upstream Disturbance	Approximately 3.65.08 (61 feet)
Test Port- Diameters to Downstream Disturbance	Approximately 4.47.08 (85 feet)
Primary Control Equipment	2-Buell ESP

3.0 Summary of Sampling Procedures

Evergreen will perform the following U.S. Environmental Protection Agency (EPA) test methods to

meet the requirements of the specified work. These methods may be referenced in Title 40 of the

Code of Federal Regulations, Part 60, Appendix A and B. The methods are titled as follows:

- Method 1   "Sample and Velocity Traverses for Stationary Sources;"

- Method 2   "Determination of Stack Gas Velocity and Volumetric Flow Rate
   (Type S Pitot Tube);"

- Method 3A   "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions
   from Stationary Sources;"

- Method 4   "Determination of Moisture Content in Stack Gases;"

- Method 7E   "Determination of Nitrogen Oxides Emissions from Stationary Sources;"

Performance Specification 2 "Specifications and Test Procedures for SO_2 and NOx Continuous

Emission Monitoring Systems in Stationary Sources;"

Performance Specification 3 "Specifications and Test Procedures for O_2 and CO_2 Continuous

Emission Monitoring Systems in Stationary Sources;"

Performance Specification 6 "Specifications and Test Procedures for Continuous Emission Rate

Monitoring Systems in Stationary Sources;"

Evergreen will also adhere to the following EPA and ASTM procedures;

EPA 600/9-7-005   1976 Quality Assurance Handbook for Air Pollution

Measurement Systems, Vol.1, Principles

EPA 600/4-77-027b   1979 Quality Assurance Handbook for Air Pollution

Measurement Systems, Vol. III.

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4.0 Methodology

4.1 Determination of Stack Gas Velocity and Volumetric Flow Rate

Measurement of gas velocity and volumetric flow rate is conducted in accordance with EPA Reference Methods 1, 2, 3A and 4 procedures. The average stack gas temperature and velocity head are measured at each traverse point, and used to calculate the gas velocity (Vs) and volumetric flow rate in acfm, scfm, and dscfm.

The sampling equipment consists of a calibrated stausscheibe (Type S) pitot tube connected to an inclined manometer to determine the velocity head at each traverse point, a thermocouple and calibrated pyrometer to measure the gas temperature at each point, and straight tap or tube connected to a slack tube manometer to determine the static pressure in the duct. Samples for flow rate determination will be collected simultaneously with the corresponding gaseous sampling runs.

Molecular weight of the stack gas is acquired by measuring the oxygen and carbon dioxide content. This will be done using EPA Reference Method 3A.

EPA Reference Method 4 is used to determine the flue gas moisture content. A gas sample is extracted from the stack and the moisture in the flue gas is condensed in an impinger train and measured. The sample train consists of a probe, filter, impinger train, pump and dry gas meter. The first and second impingers will each contain 100 ml of water, the third impinger will remain empty and the fourth impinger will contain a tare weighted quantity of silica gel. The probe is placed at each sample point and a gas sample of a minimum of 21 scf is collected.

Following sampling, the sample train is leak checked and the impinger contents measured gravimetrically and/or volumetrically to determine the quantity of water collected. Samples for moisture determination will be collected simultaneously with the corresponding gaseous sampling runs.

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4.2 Determination of O_2, CO_2, and NOx Concentrations

Instrumental Reference Method procedures for determinations of oxygen (O_2) carbon dioxide (CO_2) and nitrogen oxides (NOx) will be conducted utilizing a common sampling apparatus. The gas sample is extracted from the source at a constant rate, through a stainless steel heated probe and a heated glass fiber filter. Upon leaving the filter, the gas sample passes through a Teflon sample line heated to 250°F. The sample then passes through a VIA MAK-II gas conditioner that removes all moisture. A particulate free, dry gas sample is then suitable for instrument introduction. The analyzers that will be used for this project are listed in the table below.

Gas Constituent	Manufacturer	Model Number	Analysis Principle	Units Reported
Oxygen	Servomex	1400	Paramagnetic	(%, dry)
Carbon Dioxide	Fuji	200	Infrared	(%, dry)
Nitrogen Oxides	API	200	Chemi-luminescence	(ppmdv)

A calibration error check to show analyzer linearity is performed prior to the series of tests. The zero and high-range calibration gases for each gas constituent will be introduced directly into each analyzer. The analyzers will then be adjusted to the appropriate values. The mid-range gas will then be introduced directly into the analyzers with no adjustments made. The measured values for each calibration gas must be less than two percent of span value or the calibration error will be repeated.

A sample transport system bias will then be performed by introducing the zero and mid-range calibration gases into the sample transport system, before the filter. No adjustments to the analyzer will be made. The analyzer responses are then compared to the calibration error to determine the sample system transport bias. The bias must be less than five percent of the span value or all calibrations will be repeated. Additionally, the system response time will be determined.

Calibrations of the analyzers are then performed before and after each test run to determine the sample transport bias and analyzer drift for each run. The analyzer drift must be less than three percent of the span value or all calibrations will be repeated. The analyzer drift is used for correcting the recorded data. EPA Protocol 1 calibration gases with known concentrations will be used for all testing and calibration.

A Yokogawa data logger will be used to record all pollutant concentrations and integrate these values every minute over fifteen second intervals. These results are transferred to a computer program where average values corrected for calibration responses are reported.

5.0 Quality Assurance and Control Procedures

5.1 Quality Control Procedures

Quality control procedures for all aspects of field sampling; sample preservation and holding time; reagent quality; analytical method; analyst training and safety; and instrument cleaning, calibration and safety will be followed. These procedures are generally consistent with EPA Guidelines documented in "Quality Assurance Handbook for Air Pollution Measurement System;" Volume II, Stationary Source Specific Methods: (EPA-00/4677-027b).

The test coordinator will have overall authority and responsibility for quality assurance. All appropriate equipment will be calibrated at Evergreen's lab area prior to shipment to the job site except for the nozzles, which will be sized and calibrated on site. Copies of all calibration certification sheets will be included in the final test report. Calibration certificates will include as a minimum:

- Unique identification of equipment
- Calibration procedure used
- Acceptance criteria
- Person performing calibration
- Date of calibration
- Calibration due date (if any)
- Standard or natural constant used

5.2 Evergreen Calibration Procedures and Frequency Chart

Wet test meter: Acceptable limit of capacity >3.43m/hr (120 ft^3); accuracy within ±0.02Y, calibrated initially and then yearly by liquid displacement. Meter is adjusted until specifications are met.

Dry gas meter: Acceptable if Yi=Y±2% Calibrated vs. wet test measure initially, and when post test check exceeds ±0.05Y, recalibrate. Repair or replace if calibration fails.

Thermometers: Impinger thermometer acceptable if within ± 1°C, dry gas meter thermometer within ±3°C over range, stack temperature sensor ±1.5% of absolute temperature. Each calibrated initially as separate component against Hg in a glass thermometer; then before each field trip compare each as part of train with the Hg in glass thermometer. If calibration fails, determine constant correction factor or reject.

Probe Heating System: Capable of maintaining 248°F±25° at a flow of 0.71 ft./min. Calibrate component initially by APTD-0576, if constructed by APTD-0581 use published calibration curves. After repair, reverify calibration.

Barometer: Acceptable if within ± 2.5 mm (0.1 in) of Hg in glass barometer. Calibrate initially vs. Hg in glass barometer, check before and after each use in field. Adjust to agree with certified barometer.

Type S pitot tube: All dimension specifications will be met. Calibrated initially and before and after each test run it will be visually inspected. Pitot tubes that cannot be repaired will be replaced.

Stack gas temperature measurement system: Acceptable if capable of measuring within ± 1.5% of minimum stack temperature. It was calibrated initially and after each field testing program. If the requirements are not met, adjust to agree with Hg bulb temperature or calibration curve to correct the readings.

Appendix A